FILE

Date Out EFB: OCT 07 1982

TO: Product Manager 23 Mountfort
TS-767

FROM: Sam Creeger,
Acting Chief
Review Branch No. 1
Environmental Fate Branch
Hazard Evaluation Division

Attached please find the environmental fate review of:

Reg./File No.: 1471-RET and -REA

Chemical: Fluridone

Type Product: Herbicide

Product Name: Sonar 4AS and 5P

Company Name Elanco

Submission Purpose Registration for aquatic new use

ZBB Code: Sec 5 ACTION CODE: 110

Date in: 6/10/82 EFB # 379, 380

Date Completed: 10/5/82 TAIS (level II) Days

Deferrals To: 63 35

_____ Ecological Effects Branch

_____ Residue Chemistry Branch

_____ Toxicology Branch

1.0 INTRODUCTION

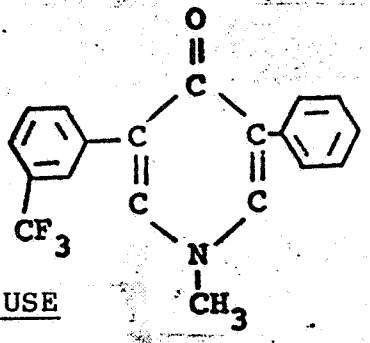
Elanco Products Company has submitted an application for registration of SONAR 5P and SONAR 4AS as a herbicide for management of aquatic weeds in ponds, lakes and reservoirs.

1.1 Chemical

Common name: Fluridone

Chemical name: 1-methyl-3-phenyl-5-(3-(trifluoromethyl)-phenyl-4(1H)-pyridinone

Structure:



2.0 DIRECTIONS FOR USE

Use directions are appended to this review.

3.0 DISCUSSION OF DATA

Data previously reviewed by EFB:

3.1 EFB review 11/1/78 Reg/file no. 1471-EUP-64 PP 8G2113. Conclusions:

3.1.1 Hydrolysis of fluridone is not a significant route of degradation. Fluridone is stable to hydrolysis.

Fluridone is extremely presistent in soil with an unpredictable half-life ranging from 6 months to 5 years according to various experimental field plots.

3.1.2 EFB review 3/2/79 Reg/file 1471-EUP-67 PP 9G2160.

Uptake and Metabolism of ^{14}C Fluridone by Bluegills. Lilly Research Laboratories. September, 1978.

Results

After 5 days static exposure (120 hours) at 0.1 and 5.0 ppm bluegills had bioaccumulation factors of 92X and 40X, respectively, were found in whole fish.

Unidentified ^{14}C residues accounted for 8.9% and 48.6% of residues resulting from 5.0 ppm and 0.1 ppm exposure, respectively.

Conclusions

Bioaccumulation factors most likely would go higher than 92X if exposure had continued through 30 days.

In this review it was noted that the octanol/water partition coefficient for fluridone was low, K_{ow} = 1.87. (Study was not reviewed by EFB at that time.) Note: k_{ow} as quoted is incorrect: K_{ow} = 74 (Log K_{ow}= 1.87, not K_{ow}). See Item 3.2.1 below.

Note. Apparently there was a later meeting with the registrant where EFB requested additional informantion on the unidentified residues.

3.2 Data previously submitted but not reviewed:

3.2.1 n-Octanol-To-Water Partition Coefficient of Fluridone. T. D. Macy and A. Loh. February, 1978. Lilly Research Laboratory. Acc. no. 097341.

Procedure

A water saturated n-octanol solution was fortified with 100 ppm ^{14}C-carbonyl-fluridone and equilibrated with n-octanol saturated water by shaking overnight. A second solution fortified at 10 ppm was shaken for one hour. The solutions were centrifuged and the aqueous layer partitioned with dichloromethane. Extracted ^{14}C was analyzed by LSC.

The partition coefficient (k) was determined by the equation:

$$\frac{C_{oct}}{C_{aq}} = \frac{\text{concentration of pesticide in n-octanol at equilibrium}}{\text{concentration of pesticide in water at equilibrium}}$$

Results

C_{oct} (ug/ml)	C_{aq} (ug/ml)	K_{ow}	Log K_{ow}
100.4	1.24	81	1.91
10.4	0.154	67	1.83

Fluridone has an average partition coefficient of 74 and log K_{ow}=1.87.

Conclusions

Fluridone has a relatively low octanol/water partition coefficient. Based on the K_{ow}=74, fluridone would have a low potential for bioaccumulation in fish.

3.2.2 Adsorption-Desorption of Fluridone on Hydrosoils. Buchanan, G.K. and W. L. Sullivan. September, 1979. Lilly Research Laboratories. Acc. no. 097341.

Procedure

Aqueous solutions were fortified with 0.09, 0.52, 1.1, and 4.4 ppm ^{14}C-n-methyl fluridone and mixed with a Mississippi loam and California silt loam hydrosoils (Soil characteristics are defiend in Table 1). Samples were held at 25° C and shaken for 16-24 hours. After equilibrium, the mixture was centrifuged and the supernate sampled. For desorptioon, deionized water was added 3 times to the soil, resuspended and mixed for additional 16-24 hour periods. Aliquots were analyzed by LSC.

The concentration of fluridone adsorbed onto hydrosoils was calculated by subtracting the pesticide concentration in the water from the initial concentration of pesticide added. The adsorption coefficient is determined using the Freundlich equation.

Results

Fluridone standards maintained during the test indicated that adsorption to walls of galss vials was not significant.

The equilibrium concentrations in hydrosoil and water showed that fluridone adsorbed to hydrosoils. Small amounts of adsorbed fluridone desorbed from the soils. Tables II and III.

Freundlich Adsortion Coefficients and Constants $^{1}/_{n}$

Soil	K_a	$^{1}/_{n}$	% O.M.	CEC (meq/100 gm)
Loam	45	0.75	8.6	14.7
Silt loam	37	0.86	11.3	11.3

Conclusions

Fluridone has relatively high potential for adsorption to hydrosoil.

No data given to indicate that equilibrium had been reached during the test period.

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3.2.4 Dissipation of ^{14}C Fluridone From Water of Artificial Ponds. D. F. Berard and D. P. Rainey. January, 1980. Lilly Research Laboratory. Acc. no. 097341.

Procedure

Outdoor artificial ponds were created containing 6 inches of loam hydrosoil (7.6% organic matter) and 30 inches well water and aged for 19 days to allow water to clear and hydrosoil to settle. ^{14}C-phenyl-, carbonyl-, and n-methyl labeled and non-labeled fluridone were added to each of the 3 ponds at a rate of 1.0 lb/surface acre. Calculated concentration of fluridone in 30 inches water column was 0.147 ppm.

Water samples were removed from the ponds at 0, 1, 2, 4, 7, 11, 21, 35, 42, 49, 59, 71, 100, and 142 days after treatment.

Analysis of ^{14}C in water before and after extraction was by LSC. Fluridone and any non-polar metabolites were extracted from the water by partition with dichloromethane. The 28, 59, and 142 day water samples were subdivided and an aliquot was acidified then extracted with ethyl acetate to extract polar metabolites.

Results

In all ponds, the radioactivity dissipated from the water with a half-life of approximately 35 days. After 142 days 17.2 - 20.0% of applied radioactivity remained in the water. Table 1.

The half-life of fluridone was approximately 21 days in all ponds. Table 2.

No metabolites were identified. Less than 1% of the applied radioactivity was recovered as non-polar metabolites. The radioactivity, as polar metabolites, was lost upon acidifying the water sample.

Conclusions

Fluridone had a half-life of approximately 21 days in artificial ponds maintained outdoors. Most likely, photolysis and/or soil adsorption are the mechanisms of dissipation in this study. Soil was not sampled.

This study does not qualify as an aerobic aquatic metabolism study. It does qualify as a supplementary photolysis study under artificial field conditions.

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The following data were submitted with the current application:

3.3 Photolysis of Fluridone in Aqueous Solution. J. W. Mosier and D. G. Saunders. Lilly Research Laboratories. January, 1982. PP 2F2709 FAP 2H5346 Acc. no. 070937 Tab 3.

Procedure

^{14}C-Carbonyl-, ^{14}C-phenyl ring-, and ^{14}C-N-methyl-fluridone solutions were prepared at 0.2 and 1.0 ppm in water (pH 6.7, 7.9 ppm dissolved oxygen) and at 1.0 ppm in nitrogen-purged water (2.0 ppm dissolved oxygen) and in buffered solutions at pH 3, 6, and 9.

Irradiation apparatus consisted of fluorescent sunlamps and fluorescent black lights in combination producing UV spectral energy similar to natural summer sunlight. A temperature of 28^{o}C was maintained during the study. The solutions were irradiated in glass ampoules which were opaque below 280 nm irradiation.

Rate studies: Ampoules were analyzed after 4, 8, 16, 24, and 32 hours irradiation. Ampoules were held in the dark as controls. Radioactivity was analyzed by LSC. Residues were extracted by partitioninng with dichloromethane. Analysis of parent fluridone was by HPLC, LSC, TLC and MS.

Identification of non-volatile photoproducts: A 50:50 aqueous/methanol solution was fortified with 500 ppm ^{14}C-carbonyl fluridone and irradiated. Samples were removed at 16, 24, 48, and 88 hours. Analysis of extracted residues was by LSC, TLC and MS.

Identification of volatile photoproducts: ^{14}C-carbonyl fluridone was dissolved in a 65:35 methanol/aqueous solution and irradiated under natural sunlight from May 11, 1979 to August 3, 1979. After irradiation the solution was analyzed by MS.

Quantification of non-volatile photoproducts: A 1 ppm aqueous sample of each of the ^{14}C solutions was irradiated for 48 hours. The residues were partitioned with dichloromethane. Analysis was by LSC and TLC.

Photolysis of fluridone and the major photoproducts in lake and distilled water: Water was fortified with 10 ppm fluridone and 1 ppm of known photoproducts and exposed to natural sunlight from July 2, 1980 to July 28, 1980 in uncovered (unless raining) Sani-Glass glass bottles.

Samples were taken at 0, 7, 14, 21, and 21 days exposure. Benzaldehydes and benzoic acids were extracted with dichloromethane partition and residues analyzed by GC. Fluridone content was determined by HPLC.

Results

Photolysis of fluridone in aqueous solution followed first order kinetics. Tables II and III.

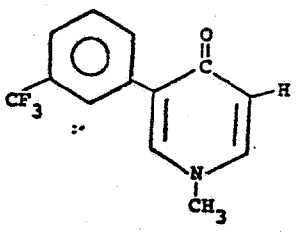
Photolytic half-life ranged from 22 hours in purged water to 55 hours in water at pH 6.

Half-lives of Fluridone During Photolysis in Aqueous Solution

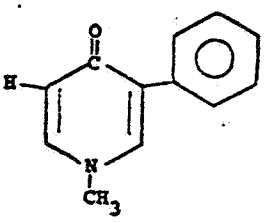
Solution	Half-life (hrs)
Water- 1.0 ppm	34
Water- 0.2 ppm	26
Water, nitrogen purged	22
pH 3 buffer	30
pH 6 buffer	55
pH 9 buffer	28

After 88 hours of exposure, in the initial photolysis study for identification of photoproducts, only 47% of the applied ^{14}C was recovered. During extraction additional ^{14}C was lost. This suggested that volatile products were formed but lost.

Two non-volatile photoproducts were identified:



Compound I



Compound II

Small amounts of ^{14}C in two other areas of the TLC plate were not identified.

Another study of non-volatile photoproducts found:

Two metabolites, compound I and benzoic acid were formed. (Compound II was not found). Several unknown photoproducts were detected by TLC but none where found in amounts greater than 6.8% of the applied ^{14}C. Table IX.

Label position	% ^{14}C Recovered*	% Distribution of extracted ^{14}C		
		Fluridone	Cmpd I	Benzoic acid
^{14}C-carbonyl	59.3**	29	2.8	14.6
^{14}C-phenyl	82.8***	31	-	-
^{14}C-N-Methyl	98.4	34	1.5	1.4

* % of initially applied recovered after 48 hours exposure.
**Lost ^{14}C not accounted for.
***Lost ^{14}C may be due to volatilization of benzaldehyde.

Fluridone in water/methanol solution and exposed to sunlight for 53 days produced volatile photoproducts: 3-CF_3-benzoic acid (III, see next page for structures), benzoic acid (IV), 3-CF_3-benzaldehyde (V), benzaldehyde (VI), N-methyl formamide (NMF, VII). These products suggest that fluridone photolysis occurs through degradation of the pyridinone ring.

Fluridone degraded steadily during exposure to sunlight in lake and distilled water. Unchanged parent fluridone accounted for 20% and 16% of the initial applied ^{14}C in distilled water and lake water after 27 days exposure, respectively. See EFB prepared table and Figures 10 & 11.

In distilled water, NMF and 3-CF_3-benzoic acid were the major photoproducts (3:1 ratio) present after 27 days exposure. In lake water, NMF, 3-CF_3-benzoic acid, and benzoic acid (1:1:1 ratio) were the major photoproducts present.

Photolysis of metabolites indicated that:
Benzaldehydes rapidly degraded. Both benzoic acids slowly degraded in distilled water but 3-CF_3 benzoic acid was stable in lake water. NMF did not degrade in lake or distilled water exposed to sunlight. NMF did completely degrade in lake water held as dark control (suggesting microbial activity involved).

Conclusions

Fluridone will photodegrade in the aqueous environment with a half-life ranging from 26 to 55 hours.

Photoproducts include volatile and non-volatile compounds. Volatile photoproducts form with the destruction of the pyridinone ring.

Volatilization of photoproducts would preclude persistence of fluridone in the environment.

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Day	% of inital ^{14}C Recovered[a]						
	Fluridone	NMF[b]	Benzaldehyde	$3CF_3$-Benzaldehyde	Benzoic acid (BA)	$3CF_3$-BA	Total
Distilled Water							
0	100	3	0.3	0.3	0.6	0.3	100
7	68	20	2	0.6	11	10	111.6
14	37	51	0.4	0.3	2	16	110.6
21	27	63	0.5	0.3	0.3	22	114
27	20	74	0.5	0.3	0.7	24	118
Lake Water							
0	100	3	0.3	0.3	0.6	0.3	100
7	70	10	0.5	0.4	16	12	108.9
14	39	21	0.5	0.3	32	27	119
21	21	33	0.5	0.3	40	33	127
27	16	36	0.5	0.4	37	29	118

[a] Table prepared by EFB from data presented in Tables XIV to XIX in report.
[b] NMF= N-methyl formamide.

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3.4 Anaerobic Aquatic Metabolism of ^{14}C Fluridone. D. P. Rainey. November, 1981. Lilly Research Laboratories. PP 2F2709 FAP 2H5346. Acc. no. 070937. Tab 4.

Procedure

Pond water and hydrosoil (sediment) from Florida, Mississippi, and California were collected (See Table 1 for soil characteristics). A 5 cm layer of soil was covered with 12 cm column of pond water in a glass tube. Colums were stored 30 days at RT for anaerobic conditions to develop.

^{14}C-carbonyl fluridone was added at rate of 1.5 lb ai/surface acre. Colums were stored in dark. Water and hydrosoil was sampled at 0, 0.5, 1.5, 3, 6, 9, and 12 months.

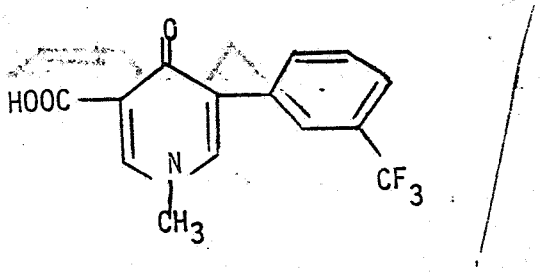
^{14}C in soil was determined by LSC of $^{14}CO_2$ of combusted soil. Residue extraction from water was by partition with dichloromethane. Residue extraction from soil was by reflux with methanol/ 2 N NaOH (1:1). After evaporation of the methanol, the aqueous phase was partitioned with dichloromethane. Extracted residues were analyzed by TLC.

Results

Over the 12 month period, the ^{14}C in water gradually decreased as the ^{14}C in hydrosoil increased. Tables 2, 3, 4.

Fluridone is persistent under anaerobic conditions in the laboratory. After 12 months, 88.5%, 74.7% and 62.6% of ^{14}C fluridone remained unchanged in the Florida, Mississippi, and California soils, respectively. No degradation occurred until after 9 months incubation in the Mississippi and California soils. This suggests that microbes can degrade fluridone but only after a microbial metabolism lag period occurred.

A single degradation product was found in the two soils:



1,4-dihydro-1-methyl-4-oxo-5-(3-(trifluoromethyl)-phenyl)-3-pyridinecarboxylic acid

Conclusions

Fluridone is stable under anaerobic aquatic conditions in the laboratory. No half-life was calculated but would be significantly greater than one year.

Microbial activity, after a lengthly lag period, will degrade fluridone under anaerobic conditions.

Note: The single metabolite found here was not found in the field dissipation study.

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3.4 Supplemental Report on the Uptake and Metabolism of ^{14}C Fluridone by Bluegills. Magnussen, J. D. and D. P Rainey. Lilly Research Laboratories. July, 1981. PP 2F2709 FAP 2H5346. Acc. no. 070937. Tab 10.

Note: this study was initiated to provide additional information on the nature of the whole body residue not identified in the study previously reviewed by EFB.

Procedure

Bluegill sunfish (1.0-3.0 gm) were exposed to well water fortified with 0.15 ppm ^{14}C-carbonyl fluridone in a static system. Fish were sampled after 24, 48, and 72 hours exposure.

Edible tissue was extracted with methanol. Extracted residues were further partitioned with water and ethyl acetate. Characterization of ^{14}C as by TLC. Confirmation of fluridone and metabolites was by co-chromatography or comparison to R_f values from earlier tests. Total ^{14}C was determined by LSC of combusted samples.

Results

Fluridone had a bioaccumulation factor (BCF) of 60X in non-edible tissue and of 1.5X in edible tissue when exposed for 72 hours.

Residues in Bluegille Exposed to 0.15 ppm* ^{14}C-Fluridone

Exposure Time (Hrs)	Non-edible Tissue		Edible Tissue	
	ppm	BCF**	ppm	BCF**
24	8.67	60.2	0.157	1.1
48	7.29	50.6	0.155	1.1
72	8.19	56.9	0.216	1.5

* Actual measured water concentration was 0.144 ppm.

** BCF= $\frac{\text{ppm tissue residue}}{\text{measured exposure water concentration}}$

Fluridone and two metabolites, metabolite A (1-methy-1-3(4-hydroxyphenyl)-5-(3-(trifluoromethyl)phenyl-4-(1H)pyridinone (compound 125670), "4-hydroxy-fluridone") and metabolite B (1-methyl-3(2-hydroxyphenyl)-5-(3-(trifluoromethyl)phenyl-4-(1H)pyridinone, ""2-hydroxy-fluridone") were the primary residues found in edible tissue. Unchanged

fluridone accounted for 61% of the total residue. Table 8.

Conclusions

Fluridone has a low potential for bioaccumulation in edible tissue of bluegills when exposed for 3 days.

Unchanged fluridone accounted for the majority of the ^{14}C residue in edible tissue.

The test duration is rather insufficient. A 30 day exposure period is preferred.

No description of water characteristics (i.e. pH, temperature, water hardness, dissolved oxygen, etc.) was given. This is very basic data that should be provided.

No depuration period was included in the test.

This study, by itself cannot support registration for an aquatic use in lieu of a valid laboratory study.

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3.5 Field Dissipation and Residue Trials with the Aquatic Herbicide Sonar in Lakes and Ponds. West, S.D. et al. Lilly Research Laboratories. February, 1982. PP 2F2709 FAP 2H5346 Acc. no. 070937. Tab 11.

Procedure

Field trials in 36 locations in the US, Panama, and Canada were conducted, including 29 ponds and 7 lakes. Pond size was 0.11 to 3.0 acres with depth 2 to 17 feet. Lake size was 2 to 10 acres with depth of 6 to 23 feet. See Table III-A for field trial locations.

Formualtions used

Sonar 5P-clay pellet uniformily surface applied.
Sonar 4AS-aqueous suspension applied either as surface (or just below) or in botton acre foot (BAF). One Canadian study used a 50% aqueous suspension surface applied.

Entire pond was treated either once at recommended rate of 0.75-1.5 lb ai/surface acre (Some ponds received a second application one year later.) Small areas of lakes were treated at 1.5 to 2.0 lb ai/surface acre.

Initial fluridone concentration was calculated to range from 0.025 to 0.123 ppm.

Water subsamples were collected at 3 places within the treated plot. Hydrosoil subsamples were collected at various locations in the treated plots. Cores were taken at 0-3 to 0-12 inch depth. Fish representing top, middle and bottom feeders were captured (by rod, electrical shocking or trapping) during the study.

Residues in water were analyzed by either GC of a brominated fluridoine derivative; HPLC of direct injected water sample; or extraction by partitioning with dichloromethane and analyzed by HPLC. Hydrosoil was analyzed either by GC of the brominated fluridone derivative or by HPLC analysis of purified hydrosoil extracts. Storage stability samples were taken for water and hydrosoil. Fish storage samples were discarded by mistake.

Fish samples were analyzed tor total residue (conjugated and free residues) and the 4-hydroxy metabolite, compound 125670, by GC of the brominated derivative.

Water, soil and fish from various ponds were sampled at

1 and 3 days, 1, 2, and 3 weeks, and 1, 2, 3, 4, 6, and 12 months after treatment.

Results

All methods of analysis used resulted in recoveries averaging at least 80%. Storage stability data indicated that compounds may be stored without significant degradation up to two months in water and at least five months in hydrosoil. (All samples were assayed within these time limits.)

Water

The maximum concentration following Sonar 4 AS application was observed one day after treatment then steadily declined. Maximum average concentration was 0.087 ppm and 0.026 ppm one day after treatment in ponds and lakes, respectively. In one treatment, the maximum concentration was 0.114 ppm 3 days after treatment. Tables IV-D & E, Figures IV-a, -b, & -c.

Treatment of small plots (2-10 acres) in lakes resulted in lower fluridone residues and faster dissipation than when entire ponds were treated. This is largely due to dispersal into untreated water. Dispersal was measured by taking samples from untreated plots within the lake.

The half-life of fluridone in pond water treated with Sonar 4 AS ranged from 5 to 60 days, with an average half-life of 20 days. After reaching a maximum concentration 2 weeks after application, the dissipation rate of Sonar 5P was similar to that of Sonar 4AS. Considering dispersal (and then degradation) the apparent average half-life of fluridone in lakes is less than 10 days. Table IV-F.

While half-life for Sonar 4AS averaged 11 days receiving surface applications and 24 days receiving botton acre-foot applications, application methods may not be responsible for the differing half-life estimate. In the study designed to determine the effect of application technique on dissipation, the half-life for both methods was 16 days. Table IV-G.

Georgaphic location by itself did not consistently influence the half-life values. Table IV-H.

Dissipation rates in all field trials resulted in very little or no carry-over of fluridone in water prior to retreatment one year later. Table I.

Hydrosoil

The average maximum hydrosoil concentration was 0.13 lb/A in ponds one month after application of Sonar 4AS (maximum concentration of 1.29 lb/A was observed 2 weeks after treatment with Sonar 5P in one pond field trial). The average maximum hydrosoil concentration of the Sonar 5P trials was 0.49 lb/A two weeks after application. Adsorption onto hydrosoil reached a maximum at one one after treatment and then steadily declined. In lakes, negligible residues occurred in hydrosoil since dispersal occurs before adsorption to hydrosoil. Tables IV-J & K, Figure IV-c.

The metabolite found in the anaerobic aquatic metabolism was not found in this study. See Item 3.4 above.

Although data from individual studies were variable, the half life in hydrosoil was approximated to be 90 days based on least squares line through that portion of the decline cure which approximated a first-order rate of decline. Figure IV-d.

Fish

Residues in fish were unchanged parent fluridone and the 4-hydroxy metabolite. Tables IV-M and -N.

The maximum total residues of fluridone and metabolite were 0.283 ppm, 1.385 ppm, and 0.965 ppm in edible, non-edible and whole body tissues, respectively. For Sonar 4AS, the maximum average total residue was observed one day after treatment in edible tissue (0.132 ppm), 2 weeks after treatment in non-edible tissue (0.528 ppm) and in whole fish (0.399 ppm). For Sonar 5P, the average maximum total residue was observed one day after treatment in edible tissue (0.067 ppm), 28 days after treatment in non-edible tissue (0.268 ppm), and in whole fish (0.185 ppm). Tables IV-O - IV-R, Figures IV-e, f, f, g, and i.

The majority of the metabolite residue was present in the non-edible tissues with very little in edible tissue. The average total residues in edible tissues and water were much less than 0.01 ppm four months after treatment. Residues in fish from lake trials were much lower than those from ponds. Tables IV-S - IV-U.

In edible fish tissue, the bioconcentration factor (BCF) for total residue ranged from 0.94X in bluegill to 2-30X in rainbow trout. For the non-edible fish parts, the BCF ranged from 3.52 in warmouth sunfish to 23.39X in rainbow trout. In whole fish the total BCF ranged from 1.59X in green sunfish to 15.51 in rainbow trout. Tables IV-V, -W, & -X.

Residues were not usually detected in fish after the fluridone had dissipated from the water.

AVERAGE BIOACCUMULATION FACTORS FOR FLURIDONE AND ITS MAJOR METABOLITE IN ALL FISH SPECIES COMBINED

Residue	Average BCF		
	Edible	Non-edible	Whole
Fluridone	1.20	3.14	3.01
4-hydroxy Fluridone	0.23	4.16	3.07
Total	1.33	7.38	8.08

Conclusions

The half-life of fluridone in the field is estimated to be 20 days in the water and 90 days in the hydrosoil.

There will be little or no carry-over of residues in water, hydrosoil or fish at the time of annual retreatment of ponds or lakes with fluridone.

Under field conditions, fluridone apparently dissipates from hydrosoil by gradual desorption into the water where it photodegrades. However, the degree of photodegradation in the aquatic field environment will be influenced by several variables, namely, degree of weed infestation, depth of water, cloud cover, etc.

Data submitted on fish bioaccumulation tend to indicate that fluridone has a low potential to bioaccumulate in fish in the field environment.

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3.6 Supplemental Studies

3.6.1 Data were submitted on the effects of fluridone on microorganims. While such studies are no longer required under current guidelines, the conclusions will be briefly mentioned.

Fluridone is relatively innocuous to selected species of bacteria, fungi and protozoa in pure culture and has no effect on soil microbial processes: CO_2 production, or starch, cellulose and protein degradation. Fluridone did not inhibit sewage microorganisms in lab experiments simulating activated sludge operations.

3.6.2 Determination of Residues of Fluridone and Its Major Metabolite in Flathead Minnows During a Full Life Cycle Study. S. D. West, et al. Lilly Research Laboratories. July, 1980. PP 2709 FAP 2H5346. Acc. No. 070937. Tab 11.

Procedure

Flathead minnows were exposed to fluridone for 9 months (during which the minnows passed through a full life cycle). Nominal concentrations of non-labeled fluridone at 0.12, 0.25, 0.50 1.0, and 2.0 ppm were maintained with a proportional diluter which intermittently delivered treated water to tanks in a flow-through system. A separate tank was maintained as a control.

Fish samples were taken at 60 days (juvenile fish), 165 days (mature fish) and 297 days (older mature fish after hatching. A second generation of fry fish were sampled 30 days after hatching. Eggs spawned but not incubated were collected and analyzed. Water was sampled weekly.

Fish samples were analyzed for whole body residueas of fluridone and the 4-hydroxy metabolite by GC of a brominated derivative. Residues in water were either analyzed by HPLC of directly injected water sample of HPLC analysis of residues extracted by dichloromethane partition.

Results

Recovery of solvent blanks spiked with fluridone and metabolite averaged 69.3± 8.6% and 69.8± 14.1%, respectively.

Water

During the exposure period, the mean measured concentration of fluridone in water was:

Nominal Concentration (ppm)	Mean Concentration (ppm)
0.12	0.12 ± 0.02
0.25	0.24 ± 0.02
0.50	0.48 ± 0.03
1.0	0.96 ± 0.06
2.0	1.9 ± 0.20

Fish

The average bioaccumulation factor for fluridone in flathead minnows is 3.23X ± 1.65. Small differences occurred ranging from BCF= 4.62 ± 1.89 for 30 day old fry fish to 1.96 for 165 day old mature fish. Table IV.

The level of fluridone in whole fish in all the life stages was directly related to the exposure concentration. The level of 4-hydroxy fluridone in whole fish tended to decrease as the age of the fish and exposure concentration increased. Table I.

Of the total residues (fluridone plus metabolite), the percentage that the metabolite comprised ranged from 86% in 30 and 60 day old fish exposed to 0.12 ppm to 21% in 297 day old fish exposed to 2.0 ppm fluridone. Table III.

Conclusions

This study is considered supplementary data. This study by itself cannot support registration for an aquatic use in lieu of a valid laboratory study.

No description of water characteristics (i.e, pH, temperature, water hardness, dissolved oxygen, etc.) was given. This basic information should be provided. EFB is unable to locate the toxicology study no. 2619-79 that the registrant references for for this information.

No depuration period was included in the test.

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4.0 EXECUTIVE SUMMARY

Fluridone is stable to hydrolysis

Fluridone will photodegrade in the environment. Photolytic half-life was 55 hours at environmental like conditions of pH 6 aqueous buffer and 28°C. Half-life was 34 hours in natural pond water. Volatile photoproducts were formed through destruction of the pyridinone ring.

Fluridone will decline at a very slow rate under anaerobic aquatic conditions with a half-life 9 months.

No aerobic aquatic metabolism study was submitted. The Registrant proposes that the anaerobic aquatic study provides adequate information on the effects of microbes on fluridone Thus a study on the sterile and non-sterile systems was not conducted. EFB believes that the registrant is confused about data requirements. EFB does not require an aerobic aquatic sterile vs. non-sterile metabolism study for aquatic non-food uses. Most likely, fluridone would be as stable under aerobic aquatic conditions as is under anaerobic conditions.

EFB is unable to determine if residues of fluridone bio-accumulation in fish. The two bluegill studies submitted are too short in duration to adequately measure the bioaccumulation potential. However, these results along with the data submitted in the field dissipation study, the flathead minnow study and the low n-octanol/water partition coefficient tend to indicate that fluridone has a low potential to bioaccumulate in fish.

Under aquatic field conditions, there will be little or no carryover of residues in water or hydrosoil.

Under field conditions, photolysis and soil adsorption are the major means by which fluridone dissipates. Desorption of soil residues into the water leads to dissipation of residues in the soil. Further degradation by photolysis would then occur. However, the rate of photolysis will be dependent on environmental variables, such as degree of weed infestation, depth of water, cover, etc.

Rotational crop data are not necessary since the label will bear a restriction against using water for irrigation f r 150 days after application to ponds or 7 days in lakes, ervoirs or until water does not contain more than 0.01 a fluridone.

5.0 RECOMMENDATIONS

5.1 EFB concurs with the conditional registration of fluridone as an aquatic herbicide provided the following studies are submitted within one year.

5.1.1 A valid laboratory fish accumulation study. This study should be conducted according to current quidelines. Test lenght should be 30 days with a 14 day depuration period at the end. Residues in whole fish, edible and non-edible tissue should be provided. A description of the water characteristics should also be provided.

5.1.2 An aerobic aquatic metabolism study conducted according to the current guidelines should be provided

5.2 All other environmental fate data requirements have been satisfied for this use.

Clinton Fletcher
Review Section 1
Environmental Fate Branch
Hazard Evaluation Division

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